INVESTIGATION OF THE EFFECT OF THE AMOUNT OF BODY USED ON THE ACCURACY AND CONSISTENCY OF PACE-RATING (MULTI-IMAGE LOOP).

BY

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INVESTIGATION OF THE EFFECT OF THE AMOUNT OF BODY USED ON THE ACCURACY AND CONSISTENCY OF FACE-RATING (MULTI-IMAGE LOOP)

A thesis

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The staff members and students of the classes of Motion and Time Study of the Second Semester of the academic year 1950-1951 for their co-operation as raters;

John H. Behl for performing as operator for the films made;

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ABSTRACT

The Purdue Motion and Time Study Laboratory and some of the plants in American industry are using the multi-image loop to help the pace-rating step of the procedure used to determine time standards. The loop has been found helpful in improving accuracy and consistency, and it seems to be one of the best answers so far arrived at in this controversial field.

One of the objections presented as a weakness of the loop is that it shows only essentially an arm movement and raters have difficulty in comparing the pace as shown by this movement with other types of movement using different members of the body.

The author of this thesis endeavored to investigate the subject mentioned in the previous paragraph. Different jobs involving different body members were filmed at different paces and raters were asked to pace-rate them; first unaided, and secondly aided by the loop.

The results were compared and subjected to statistical analysis from the view point of both accuracy and consistency.

Results

1. From the point of view of accuracy:

   a. The accuracy in rating was significantly improved, at least in some paces, in all jobs except the one consisting of walking. In this job, the accuracy in rating

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The Purdue Motion and Time Study Laboratory and some of the plants in American industry are using the multi-image loop to help the pace-rating step of the procedure used to determine time standards. The loop has been found helpful in improving accuracy and consistency, and it seems to be one of the best answers so far arrived at in this controversial field.

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The results were compared and subjected to statistical analysis from the view point of both accuracy and consistency.

Results

1. From the point of view of accuracy:

a. The accuracy in rating was significantly improved, at least in some cases, in all jobs except one where the variation of working. In this job, the accuracy in rating

was significantly poorer with the loop than without it.

b. In no case, except in the job consisting of walking, was rating significantly poorer with the loop than without it.

2. From the viewpoint of consistency:

a. The jobs consisting of full arm and forearm movement were the only ones that in all cases were rated significantly better when using the loop.

b. The jobs consisting of fingers and trunk movements were rated significantly poorer in the aided condition.

c. The jobs consisting of walking and wrist movement did not show conclusive results.

Conclusions

It can be said with a considerable amount of confidence, from the results already stated, that, except in the case of the walking job, the loop helped the raters considerably in improving their accuracy, even when it did not improve their consistency. This seems to indicate that the loop is a powerful means to impose a uniform concept of standard pace upon a group of individuals, except in the case of walking and, probably, movements of the whole body. Also, with due consideration given to the exception already pointed out, use of the loop seems to decrease the known tendency to rate low-paced performance high, and high-paced performances low.

was significantly poorer with the tool than without it.

b. In no case, except in the job completing of walking, was rating significantly poorer with the tool than without it.

8. From the viewpoint of comfortableness:

c. The jobs completing of left arm and forearm movement were the only ones that in all cases were rated significantly better when using the tool.

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c. The jobs completing of walking and motor movement did not show conformable results.

Conclusions

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INTRODUCTION

Time study has been, since its introduction in the field of Engineering, a fascinating and controversial subject. Besides other uses, Time Study is a great stride towards the highly appealing objective of having all the employees in an organization paid fairly and equitably.

However, even a small amount of thought can immediately show the enormous difficulties in setting these standards. As one goes deeper into the subject, the difficulties seem to increase both in degree and in amount.

Without doubt, the most difficult step in setting time standards is the appraisal of the effort that the operator is expending in performing the job being studied. Some leaders in the subject,[1] among them Dr.

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1. Presgrave, R., "Dynamics of Time Study", New York, N. Y., Mc Graw-Hill Book Co., 1945.

M. E. Mundel [2] and his associates of the Purdue Motion and Time Study Laboratory, have tried to decrease the diffi-

ON THE ACCOUNTING FOR CONSISTENCY OF LABOR-HOURS IN THE AMOUNT OF BODY USED IN MAKING A PAIR OF SHOES

(MULTI-ITEM TASK)

INTRODUCTION

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[1] Freeman, P., "Principle of Time Study", New York, Mc Graw-Hill Book Co., 1945.

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[2] P. Mundel [2] and his associates of the Purdue Center

2. Mundel, M. E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950.

culty of this step by separating job difficulty from the rating. The rater, according to their procedure, is concerned with pace alone, and rates only this element of the performance; in other words, he pace-rates the performance. All other factors of the job are taken care of, posteriorly, by means of secondary adjustments.(3)

3. Mundel, M. E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950.

As a further way of improving rating procedure, Dr. Mundel and his associates developed a motion picture film that shows twelve images simultaneously; in each image, the same simple job is performed, the pace varying from image to image, ranging from 79 to 156 percent of normal pace. The job being performed involves essentially an arm movement. In order to facilitate continuous projection of the film for relatively long periods of time, the film used is in the form of a loop, with its ends cemented together. It is known as the multi-image loop and, in this thesis, will be called simply the loop.

It has been shown by a study of the works of Keim,(4)

3. Hunt, M., "Motion Sickness", Scientific American, New York, Fiction-Hall, 1990.

2. Hunt, M., "Motion Sickness", Scientific American, New York, Fiction-Hall, 1990.

Lehrer[5] and Ela[6], that among over 4,000 ratings ob-

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4. Keim, J. A., "An Evaluation of Time Study Rating", Master's Thesis, Purdue University, 1950.
5. Lehrer, R. M., "An Evaluation of Two Time Study Rating Aids", Master's Thesis, Purdue University, 1947.
6. Ela, A. J., "An Analysis of Current Practice Unaided Time Study Rating", Master's Thesis, Purdue University, 1950.

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tained from unaided experienced time study men, in 45% of the time the error in rating was greater then 10%. These results show how techniques to improve accuracy in rating, as the loop just described, are needed.

The loop has been evaluated against raw rating[7] and other rating techniques and has been found helpful in improving in general both accuracy and consistency.[8] How-

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7. For detailed description of raw rating see: Ela, A. J., "An analysis of Current Practice Unaided Time Study Rating", Master's Thesis, Purdue University, 1950.
8. Radkins, A. F., "Comparison and Evaluation of Three Time Study Rating Techniques", Masters Thesis, Purdue University, June, 1950. Mundel, M. E., "Motion and Time Study, Principles and Practice", New York, Prentice-Hall, 1950. "Report of 5th. Annual Motion and Time Study Work Session, 1950", Purdue University.

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ever, the investigations to-date definitly show that there is still a very large field for improvement, since the results of the use of the loop have been far from perfect. Its use still does not eliminate the human judgement existing in pace-rating, which is indeed the heart of the diffi-

culty of the step.

One of the objections that the users of the loop have offered is that it becomes difficult to compare the pace of the job being studied with those shown in the loop when the body member being used and the type of movement in the job differ markedly from those of the loop.(9) The difficulty

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9. Tseng, A. T., "An Evaluation of the Effectiveness of Retention of the Concept of a Standard Embodied in a Multi-Image Pace-Rating Loop", Unpublished Master's Thesis, Purdue University.

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is easy to understand when one remembers that we are trying to evaluate accelerations of body members and that the impression of pace caused by different body members making different types of movements may vary, even if the acceleration in reality is the same.

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9. Tsang, W. T., "An evaluation of the effectiveness of Retention of the Concept of a Standard Embodied in a Multi-Image Face-Rating Tool", Unpublished Master's Thesis, Maine University.

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PURPOSE

The purpose of this thesis is to investigate the effect of the amount of the body used on the consistency and accuracy of pace-rating, when the rater is using the multi-image loop as a rating aid. In other words, this thesis will investigate how ratings made with the help of the loop vary as the body members involved in the job being rated also vary.

PURPOSE

The purpose of this thesis is to investigate the effect of the amount of the body used on the consistency and accuracy of pace-rating, when the rater is using the multi-image loop as a rating aid. In other words, this thesis will investigate how ratings made with the help of the loop vary as the body measure involved in the loop being rated also vary.

PROCEDURE

Six laboratory-type jobs were chosen by the author and filmed. The jobs were kept very simple and very definitely designed so as to have successively larger groups of body members involved in activity. Three paces of each job were filmed, the pace being controlled by a metronome. The following types of jobs were filmed:

Job 1. The operator turns a nut on a 3/4" bolt, using fingers only.

Job 2. The operator turns a 16 mm. movie wheel, supported on a rewinder, using mainly wrist motion.

Job 3. The operator touches successively two plate switches, about twenty inches apart, on a horizontal plan, using only fore-arm motion.

Job 4. The operator places metallic balls into a hole, one by one, after grasping them at a bin about seventeen inches from the hole; he uses here full arm motion.

Job 5. The operator picks up light small boxes from the floor one by one, and places them on the top of an average-size table thirty inches in height; the trunk is here the most important body member as far as the control of the pace goes. The operator

INCORRECT

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bucel of each lop more lifted, the bone point conficting

pa = mesronome. The lifting Cyber 1 lope were lifted:

lop 1. The observer fixes a nap on a 3/4" bolt,

weild fiqhon cut.

lop 2. The observer makes a 12 mm. maxie meter

cylor section.

lop 3. The observer removes incoherency and

"ti to smiqhns, sprat rhomfy inches

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lop 4. The observer fuses ...ertio pi tie rup

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rried ne nwe pio ifte pi ...rrr.

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was instructed to keep his arms rigid with respect to his trunk.

Job 6. The operator walks in front of the camera, normal to the axis of the lens of the camera.

Two groups of raters were used. One group was composed of students of the Elementary Motion and Time Study classes and will be called Group A, for convenience; the other group was composed of Staff Members of the Industrial Engineering Department and students of the Advanced Motion and Time Study classes with some experience in rating with the loop and will be called Group B. The first group have had no experience at all in rating.

The several sequences were filmed at the rate of 1,000 frames per minute and projected at the same speed. The films were cemented in sequence, in the following order. The paces were randomized:

Films order	Job and pace
1.	Job 1, slow.
2.	Job 4, medium
3.	Job 6, fast
4.	Job 2, fast
5.	Job 3, fast
6.	Job 5, medium
7.	Job 1, fast
8.	Job 4, fast
9.	Job 6, medium
10.	Job 2, medium
11.	Job 3, medium
12.	Job 5, slow
13.	Job 1, medium
14.	Job 4, slow
15.	Job 6, slow
16.	Job 2, slow

was instructed to look his case right

with respect to Mic Trunk.

Top 6. The operator moves in front of the camera,

horizt to the axis of the lens of the

camera.

Two blanks of indard note used. One blank was com-

posed of sequence of the Mcnaughtall Motion and Time study

classes and will be called Blank 5, for convenience; the

other blank was composed of test members of the Incentive

Engineering department and elements of the Advanced motion

and Time Study classes with emphasis in setting stan-

dard Time. The first blank was used in testing stan-

dardization of set in testing.

The material as finally used is shown at the rate of 1,000

Lamps per minute and projected on the test screen. The title

were observed in sequence, in the following order. The

Lamps for minute and projected on the test screen. The title

Time Film

Top and Side

Films order	Job and pace
17.	Job 3, slow
18.	Job 5, fast

The words slow, medium and fast are used in this thesis only in a comparative sense within the same job.

The same set of instructions were written on a blackboard each time the film was going to be shown to raters. The set of instructions consisted of the definition of pace, a caution to pay no attention to the job difficulty; and, when the loop was used, a statement asking raters to try to use the loop to its greatest possible advantage was added.

The raters first rated the sequence of jobs without the loop, based on their own individual concept of normal pace as defined by Dr. Mundel. All raters were quite familiar with this definition.

After a period of about two weeks, the sequence was again shown to the raters and the rating done with the help of the loop, projected side by side with the film. The correct pace of each image was shown also on a convenient place where it could be seen during rating. During both rating periods, the control of the speed of projection was made continuously with the aid of a strobotac, assuring the speed of 1,000 frames per minute.

The two weeks period was allowed in order to minimize any carry-over effect, i.e. the effect of the retention of the rating assigned in the unaided situation.

Before projecting the sequence of jobs, the loop alone

Time order	Top and Pros
17.	Top 3, Pros
To.	Top 3, Pros

The voice slow, motive and lack are used in this speech only in a comparative sense with the same act.

The same act of instantaneous mode written on a piano-board when the film was going so as shown to score. The act of instantaneous completion of the definition of pace, a complete it and it existent to the two definitions; and, when the room was used, a difference existed between it to use one or the greatest possible advantage was gained. The second time rose the existence of some without the room, based of short own indifferent strong and young pace as defined by it. Second. It refers more time definitions with some definitions.

Under a point of [illegible] pace, the second was [illegible]

was projected for a period about 3 minutes. The objective of this was to give to the raters a chance to form in their mind a concept of several paces as shown by the loop.

After the data was gathered, two studies were made: one of the consistency of the group , and the other of the accuracy.

In the study of the consistency, the raw ratings average was taken, and the percentage of ratings that approached the raw average within 5, 7.5 and 10 percent was calculated, in each of the two situations, namely, unaided and aided. Then, the differences of percentages in each group and between the two situations were tested for significance using Student's t variable.

In the study of accuracy, since the true paces are unknown, a determination of values to be considered as true ones had to be adopted. The following was done in this thesis:

a. The operator performing the job was paced by a metronome. This assured a reasonably constant pace, which was further checked by actual frame-counting.

b. The metronome beats were taken as indicating the right proportionality among the paces of each individual job.

c. In each job, the pace whose raw ratings

[illegible] the boss whose ram ratings

[illegible]

[illegible]

[illegible]

[illegible] "Patent Pete", whose ram [illegible] observed

[illegible] by a spectator, Eric Bowring [illegible]

a. The operator, multiplying the lap was placed

this manner:

time once and to be sampled. The rotating was done in

muscle, a determination of values to be considered as

In the study of sound [illegible], since the true beam ra-

ceive using Lindauer's [illegible].

In the study of sound [illegible], since the true beam re-

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In the study of the two situations, namely, wanded and

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[illegible] for a period about 3 minutes. The objective

average in the four conditions (unaided and aided in each of the two groups) agreed most closely was found. The mean of the averages in the four conditions was selected as the corrected rating for this pace. Then, the corrected ratings for the other paces was determined proportionately with the help of the metronome beats.

After the corrected ratings were thus determined, the same procedure adopted in the study of consistency was used to study accuracy, the difference obviously being that the basis for the consistency study was the averages of the raw ratings, while the basis for the accuracy study was the corrected ratings.

of the reference peaks.

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DATA

The data for this thesis was obtained from two groups of raters:

1. Group A. This group was composed of about 100 students of the Elementary Motion and Time Study classes; they had had no experience either in rating or in the use of the loop.

2. Group B. This group was composed of about 20 raters, some being staff members of the Industrial Engineering department and some being students of the Advanced Motion and Time Study classes. This group was experienced in rating and had already used the loop to some extent. However, no member of this group had continuous recent practice, in either rating or the use of the loop.

The two groups were separated for study in order to maintain their homogeneity as rating groups. This separation, added to the fact that the number of members of the group A is relatively large, permitted us to assume safely statistical normality to the samples (ratings) variations obtained from the latter group.

Due to the relatively small number of members of the group B, the assumption of normality of the distribution of the ratings could not be considered valid. Therefore, the reliability of the significance of the Student's test made is not nearly as high as that of the study run on the class A ratings. However, the study was made to see

DATA

The data for this thesis was obtained from two groups of raters:

1. Group A. This group was composed of about 100 students of the Elementary Motion and Time Study classes; they had had no experience either in rating or in the use of the loop.

2. Group B. This group was composed of about 50 raters, some being staff members of the Industrial Engineering department and some being students of the Advanced Motion and Time Study classes. This group was experienced in rating and had already used the loop to some extent. However, no member of this group had consistent recent practice, in either rating or the use of the loop.

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if the results would indicate considerable differences between the two groups. That was not the case.

Recognition must also be accorded to the fact that experience of raters varied widely within group B, but was constant within group A. For this reason, group B was used as an aid to establish the correct values for measuring accuracy, and comparisons of performances were made principally from ratings made by group A.

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DEFINITIONS AND EXPLANATION OF TERMS

Certain terms are used in the thesis with a particular meaning that may be unfamiliar to the reader. To avoid confusion due to this, these terms are defined as follows:

Pace

Pace is defined here as the amount of acceleration imparted by the operator on the body members in motion during the performance.

Normal Pace

100% on a scale with 130% representing maximum typical performance.

Consistency

Consistency expresses the degree to which ratings assigned to each performance by a group of raters agree with each other. See Procedure .

Accuracy

Accuracy expresses the degree to which the ratings assigned to each performance agree with the rating that should be assigned to the performance. Since the exact pace is truly unknown, what should be assigned as the rating of each performance has to be determined by some means. The way that this determination was made in this thesis is explained in the Procedure.

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RESULTS

All the results arrived at in this thesis are shown in Appendix A.

Those results can be summarized as follows:

1. From the point of view of accuracy:

a. The accuracy in rating was significantly improved, at least in some paces, in all jobs except the one consisting of walking. In this job, the accuracy in rating was significantly poorer with the loop than without it.

b. In no case, except in the job consisting of walking, was rating significantly poorer with the loop than without it.

2. From the viewpoint of consistency:

a. The jobs consisting of full arm and forearm movement were the only ones that in all cases were rated significantly better when using the loop.

b. The jobs consisting of fingers and trunk movements were rated significantly poorer in the aided condition.

c. The jobs consisting of walking and wrist movement did not show conclusive results.

In order to show also the manner by which the use of the loop improved the accuracy of the raw averages of the class A group, a graph was drawn and inserted in Appendix A (Fig. 1). This graph shows that the use of the loop had a considerable effect in bringing the raw averages nearer to

RESULTS

All the results arrived at in this thesis are shown in Appendix A.

These results can be summarized as follows:

1. From the point of view of accuracy:

a. The accuracy in testing was significantly improved, at least in some cases, in all jobs except the one consisting of walking. In this job, the accuracy in testing was significantly poorer with the load than without it.

b. In no case, except in the job consisting of walking, was testing significantly poorer with the load than without it.

2. From the viewpoint of consistency:

a. The jobs consisting of limit run and forearm movement were the only ones that in all cases were tested significantly better when using the tool.

b. The job consisting of fingers and thumb movements were tested significantly poorer in the added condition.

c. The jobs consisting of walking and wrist movement did not show consistent results.

In order to show what the answer by which the use of the tool improved the accuracy of the testing of the grip strength a study was made [illegible] the [illegible] (11, 1). This study was done on the [illegible] the tool improved the accuracy of the testing of the [illegible] significantly better when using the tool. In this job, the accuracy in testing was significantly poorer with the load than without it.

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the 45° line, in other words, to the corrected values that should have been assigned to the several paces of the jobs. The only exception is the job consisting of walking whose unaided raw ratings averages were not helped by the loop to any degree, confirming the results already stated in the previous paragraph.

the 45° line, in other words, to the corrected values that should have been assigned to the several pages of the job. The only exception is the job consisting of working whose unaided raw ratings averages were not helped by the loop to any degree, conflicting the results already stated in the previous paragraph.

CONCLUSIONS

The conclusions arrived at by the author should be considered with the following thoughts kept in mind:

1. Group A had had no experience in either pace-rating or the use of the loop. It has been already shown that the effectiveness of the loop increases considerably after a certain period of training and practice with it.(10)

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10. Tseng, A. T., "An Evaluation of the Effectiveness of Retention of the Concept of a Standard Embodied in a Multi-Image Pace-Rating Loop", Unpublished Master's Thesis, Purdue University.

Therefore, the results arrived at in favor of the loop should be interpreted as having even greater significance. Also, the results against the loop should be regarded as possibly being due to a condition that could be eliminated or greatly reduced with further training and practice with the loop.

2. It has also been shown that the effectiveness of retention in an individual's mind of the concept of standard embodied in the loop is considerable.(11) The re-

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11. Tseng, A. T., op. cit.

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2. It has also been shown that the effectiveness of retention in an individual's mind of the concept of [illegible] separate examples in the loop is [illegible] the re-

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11. Tsang, A. T., op. cit.

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suits arrived at by Group B have not fully been influenced

by this. However, this could not have been the case with the results from Group A.

3. Because of the facts explained in the Data section of this thesis, the conclusions were drawn based mainly on the study made of the ratings from Group A.

The conclusions made by the author after a study of the results are:

1. Except in the job consisting of walking, the loop proved to be a powerful means to improve the accuracy of pace-rating, even when it did not improve consistency.

2. The loop proved to be considerably more valuable in improving the consistency of pace-rating in the cases of jobs involving body members identical to those shown in the loop, than in all the cases where the body members were other than those shown in the loop.

3. The loop seems to be a powerful means to establish a concept of standard among a group of individuals.

4. The loop proved to be particularly helpful in improving the accuracy of the ratings when the pace of the job is well above the normal. Unfortunately, the fast pace of the walking job (the only one whose ratings were not improved in accuracy) was not well above the normal. It was about 115%. Therefore, nothing can be said for this job in the aspect being considered in this paragraph.

by this. However, this could not have been the case with the results from Group A.

3. Because of the facts explained in the beginning of this thesis, the conclusions were drawn based mainly on the study made of the ratings from Group A.

The conclusions made by the author after a study of the results are:

1. Except in the job consisting of walking, the loop proved to be a powerful means to improve the accuracy of pace-rating, even when it did not improve consistency.

2. The loop proved to be considerably more valuable in improving the consistency of pace-rating in the cases of jobs involving body members identical to those shown in the loop, when in all the cases where the body members were other than those shown in the loop.

3. The loop seems to be a powerful means to establish a concept of standard among a group of individuals.

4. The loop proved to be particularly helpful in improving the accuracy of the ratings when the pace of the job is well above the normal. Unfortunately, the fast pace of the walking job (the only one whose ratings were not improved in accuracy) was not well above the normal. It was space rich. Therefore, nothing can be said for this job in the reference being considered in this bibliography.

SUGGESTIONS

From the comments obtained from the raters who performed for this thesis and the author's own observations, the following suggestions are made here:

1. The length of time during which a job filmed should be exposed to the raters, in order to provide adequate time for comparison with the loop, should be investigate. The length of time used by the author, about 30 seconds, was considered too short by a few raters.

2. The number of images in a multi-image loop that can provide adequate spacing between the paces, and, at the same time, permit a quick and easy comparison between the loop and the job being studied should be investigated.

3. The author found out that there is no uniform mental process when raters use the loop. Some raters try first to obtain in their minds a good concept of the pace of the job being studied, and then they look at the loop for comparison. Other raters keep their eyes moving from the job to the loop and vice-versa, thus trying to make the comparison. It seems to the author that the first process is more efficient and even more accurate. However, this is just a personal opinion. The matter should be investigated. At least, in investigations in-

CONCLUSIONS

From the comments obtained from the raters who performed for this thesis and the author's own observations, the following suggestions are made here:

1. The length of time during which a job filmed should be exposed to the raters, in order to provide adequate time for comparison with the loop, should be investigated. The length of time used by the author, about 30 seconds, was considered too short by a few raters.

2. The number of images in a multi-image loop that can provide adequate spacing between the pieces, and, at the same time, permit a quick and easy comparison between the loop and the job being studied should be investigated.

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volving the loop, the procedure should be standardized.

4. It is possible that jobs involving the same pace of the same body member, but with different displacement or length of movement, may be rated differently; in other words, the tendency may be to count specific movements rather than to rate from an overall impression of acceleration. This might be a problem that would be interesting to investigate.

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4. It is possible that jobs involving the same piece of the same body member, but with different displacement or length of movement, may be rated differently; in other words, the tendency may be to count specific movements rather than to rate them on overall impression of acceleration. This might be a problem that would be interesting to investigate.

APPENDIX A

TABLES OF DATA AND STATISTICAL RESULTS

APPENDIX A

TABLES OF DATA AND STATISTICAL RESULTS

Table 1. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings, from the Viewpoint of Consistency at the 5% Level of Significance.

Key:

- means that no significant difference was found.
*means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

Table 1. Display of the Significant Difference in Percentage Relations Between the Unaided and the Aided Situations in the Close A Ratings, From the Viewpoint of Consistency at the 5% Level of Significance.

Key:

- means that no significant difference was found.
* means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
i means that the difference was in favor of the use of the loop.

	Slow pace	Medium pace	Fast pace
		Job 1	
Within 5%	A*	-	-
Within 7.5%	-	-	-
Within 10%	A*	-	A
		Job 2	
Within 5%	-	-	-
Within 7.5%	-	F	-
Within 10%	-	F*	A*
		Job 3	
Within 5%	-	F*	F
Within 7.5%	-	-	-
Within 10%	-	F*	-
		Job 4	
Within 5%	F*	-	-
Within 7.5%	F*	-	F*
Within 10%	-	-	F*
		Job 5	
Within 5%	A*	-	-
Within 7.5%	A*	A*	-
Within 10%	-	-	-
		Job 6	
Within 5%	-	F*	-
Within 7.5%	A*	A	-
Within 10%	A*	-	-

	Slow pace	Medium pace	Fast pace
Top 1			
Within 5%	A*	-	-
Within 7.5%	-	-	-
Within 10%	A*	-	Y
Top 2			
Within 5%	-	-	-
Within 7.5%	-	F	-
Within 10%	-	F	K*
Top 3			
Within 5%	-	J*	I
Within 7.5%	-	-	-
Within 10%	-	J*	-
Top 4			
Within 5%	K*	-	-
Within 7.5%	I*	-	K*
Within 10%	-	-	K*
Top 5			
Within 5%	A*	-	-
Within 7.5%	I*	K*	-
Within 10%	-	-	-
Top 6			
Within 5%	-	I*	-
Within 7.5%	I*	K	-
Within 10%	A*	-	-

Table 2. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings, from the Viewpoint of Consistency, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
* means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

Table 8. Display of the Significant Differences in Percentage Deviations Between the Unaided and the Aided Situations in the Class E Ratings, From the Viewpoint of Consistency, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
+ means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

	Slow pace	Medium pace	Fast pace
		Job 1	
Within 5%	A	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-
		Job 2	
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
		Job 3	
Within 5%	-	-	-
Within 7.5%	-	F*	-
Within 10%	-	-	-
		Job 4	
Within 5%	-	-	-
Within 7.5%	-	F	F*
Within 10%	-	-	F
		Job 5	
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
		Job 6	
Within 5%	-	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-

	Slow pace	Medium pace	Fast pace
Job 1			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 2			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 3			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 4			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 5			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Job 6			
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-

Table 3. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
* means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

Table 5. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class A Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
* means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

	Slow pace	Medium pace	Fast pace
		Job 1	
Within 5%	-	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*
		Job 2	
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
		Job 3	
Within 5%	-	-	-
Within 7.5%	-	F	F*
Within 10%	F	F	F*
		Job 4	
Within 5%	-	F*	F
Within 7.5%	-	F	F*
Within 10%	-	F*	F*
		Job 5	
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
		Job 6	
Within 5%	A	-	A*
Within 7.5%	-	-	A*
Within 10%	A	-	A*

	Slow pace	Medium pace	Fast pace
Top 1			
Within 3%	-	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*
Top 2			
Within 3%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Top 3			
Within 3%	-	-	-
Within 7.5%	-	F	F*
Within 10%	F	F	F*
Top 4			
Within 3%	-	F*	F
Within 7.5%	-	F	F*
Within 10%	-	F*	F*
Top 5			
Within 3%	-	-	-
Within 7.5%	-	-	-
Within 10%	-	-	-
Top 6			
Within 3%	-	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*

Table 4. Display of the Significant Difference in Percentage Deviations Between the Unaided and the Aided Situations in the Class B Ratings from the Viewpoint of Accuracy, at the 5% Level of Significance.

Key:

- means that no significant difference was found.
* means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the loop.
F means that the difference was in favor of the use of the loop.

Table 4. Display of the significant difference in percentage deviations between the Unaided and the Aided situations in the Class B Redings from the Viewpoint of Accuracy, at the 5% level of significance.

Key:

+ means that the significant difference was found.
- means that the difference was significant also at the 1% level of significance.
A means that the difference was against the use of the tool.
F means that the difference was in favor of the use of the tool.

	Slow pace	Medium pace	Fast pace
		Job 1	
Within 5%	-	-	-
Within 7.5%	F*	F	-
Within 10%	F*	F	-
		Job 2	
Within 5%	F*	-	-
Within 7.5%	-	-	F*
Within 10%	-	-	F*
		Job 3	
Within 5%	F	-	F
Within 7.5%	-	F*	F*
Within 10%	-	F*	F*
		Job 4	
Within 5%	-	-	F*
Within 7.5%	F	-	-
Within 10%	-	-	-
		Job 5	
Within 5%	-	-	-
Within 7.5%	-	-	-
Within 10%	F*	-	-
		Job 6	
Within 5%	-	-	-
Within 7.5%	A	-	-
Within 10%	-	-	-

	slow pace	medium pace	fast pace
top 1			
within 3%	-	-	-
within 7.5%	F*	F	-
within 10%	F*	F	-
top 2			
within 3%	F*	-	-
within 7.5%	-	-	F*
within 10%	-	-	F*
top 3			
within 3%	F	-	F
within 7.5%	-	F*	F*
within 10%	-	F*	F*
top 4			
within 3%	-	-	F*
within 7.5%	F	-	-
within 10%	-	-	-
top 5			
within 3%	-	-	-
within 7.5%	-	-	-
within 10%	F*	-	-
top 6			
within 3%	-	-	-
within 7.5%	-	-	-
within 10%	-	-	-

Table 5. Percentages of the Class A Ratings Within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Aided and in the Unaided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	27.10	11.71	28.97	18.92	47.66	20.72
2.	27.36	27.93	43.39	44.14	57.58	58.56
3.	24.30	26.13	37.38	40.54	47.66	53.15
4.	22.43	13.51	22.43	27.03	60.75	42.34
5.	13.21	45.05	41.51	54.05	54.72	63.00
6.	20.75	18.18	44.34	21.82	44.34	37.27
7.	18.69	24.54	19.63	28.18	53.27	40.00
8.	41.12	37.27	41.12	62.73	43.93	71.82
9.	24.30	40.91	65.42	50.00	69.16	59.09
10.	25.23	32.43	29.91	44.14	29.91	59.46
11.	13.08	30.91	31.78	40.00	31.78	49.09
12.	46.73	29.36	61.68	39.45	63.55	55.05
13.	29.91	26.13	62.62	49.55	64.49	55.86
14.	14.95	45.95	14.95	62.16	62.62	67.57
15.	33.64	36.94	65.42	47.75	70.09	50.45
16.	22.43	27.03	45.79	45.95	50.47	53.56
17.	21.50	31.53	38.32	41.44	44.86	46.85
18.	23.36	32.43	43.93	51.35	56.07	61.26

Key: U; Unaided; A: Aided Situation.

Table 5. Percentages of the Class A Ratings Within Given Percentage Deviations From the Raw Ratings Averages (Consistency) in the Aided and in the Unaided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	27.10-11.71		28.97-18.98		47.68-20.72	
2.	27.36-27.98		43.39-44.14		57.38-58.56	
3.	24.30-26.13		37.38-40.54		47.66-55.15	
4.	22.45-15.57		22.43-27.03		60.78-42.54	
5.	13.21-45.03		41.31-54.03		54.72-63.00	
6.	20.75-18.18		44.34-31.82		44.34-37.27	
7.	16.89-24.54		19.62-28.18		32.27-40.00	
8.	41.12-37.27		41.18-62.73		43.93-71.82	
9.	24.30-40.91		63.42-50.00		69.16-59.09	
10.	29.23-32.43		29.91-44.14		29.91-59.46	
11.	13.08-30.91		31.76-40.00		31.76-49.09	
12.	40.72-29.36		41.69-39.45		63.38-05.05	
13.	29.81-29.13		25.62-49.55		64.49-53.86	
14.	14.93-43.93		14.33-51.16		62.62-67.57	
15.	33.64-36.94		33.42-47.75		70.09-50.45	
16.	22.43-27.03		43.79-45.95		30.47-33.56	
17.	21.50-31.33		39.32-41.44		44.86-46.85	
18.	25.38-25.43		43.93-31.35		36.07-41.29	

Key: U; Unaided; A: Aided situation.

Table 6. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 5.

Film No.	5%	7.5%	10%
1.	2.874	1.738	4.196
2.	0.094	0.111	0.147
3.	0.312	0.480	0.811
4.	1.719	0.789	2.720
5.	5.186	1.855	1.240
6.	0.310	3.560	1.065
7.	1.050	1.482	1.966
8.	0.584	3.197	4.188
9.	2.624	2.311	1.552
10.	1.176	2.179	7.103
11.	3.184	1.267	2.597
12.	2.644	3.280	1.280
13.	0.477	1.948	1.306
14.	4.984	7.164	0.769
15.	0.510	2.673	2.967
16.	0.788	0.011	1.200
17.	1.683	0.471	0.295
18.	1.494	1.099	0.779

Table 8. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 5.

Film No.			
1.	2.174	1.750	0.190
2.	0.094	0.111	0.147
3.	0.312	0.480	0.811
4.	1.716	0.729	2.750
5.	3.138	1.855	1.240
6.	0.810	2.860	1.065
7.	1.092	1.486	1.966
8.	0.234	2.127	4.188
9.	1.814	.311	1.852
10.	1.176	2.179	2.103
11.	2.186	1.827	2.297
12.	1.114	0.0	1.290
13.	0.477	1.242	1.306
14.	0.094	2.101	0.790
15.	0.310	1.272	2.807
16.	2.788	0.011	1.800
17.	1.8..	.471	.185
18.	1.6..	2....	..272

Table 7. Percentages of the Class B Ratings Within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	42.86	11.76	52.38	23.53	61.90	47.07
2.	38.10	66.67	38.10	72.22	66.67	72.22
3.	52.38	22.22	52.38	55.56	80.95	55.56
4.	33.33	33.33	57.14	44.44	71.43	50.00
5.	38.10	50.00	47.62	77.78	57.14	83.33
6.	14.29	22.22	47.62	33.33	52.38	66.67
7.	33.33	33.33	33.33	61.11	47.62	72.22
8.	33.33	50.55	38.10	83.33	66.67	94.44
9.	42.86	22.22	61.90	50.00	66.67	50.00
10.	52.38	47.06	52.38	58.82	61.90	70.59
11.	23.81	33.33	28.57	72.22	42.86	72.22
12.	38.10	22.22	38.10	22.22	61.90	66.67
13.	33.33	22.22	52.38	33.33	57.14	33.33
14.	61.90	38.89	61.90	66.67	80.95	77.78
15.	47.62	22.22	66.67	33.33	71.43	50.00
16.	38.10	27.78	47.62	38.89	47.62	44.44
17.	14.29	27.78	23.81	27.78	28.57	44.44
18.	33.33	27.78	33.33	38.89	57.14	66.67

Key: U: Unaided situation; A: Aided situation.

Table 7. Percentages of the Class B Ratings within Given Percentage Deviations from the Raw Ratings Averages (Consistency) in the Unaided and the Aided Situations.

Film No.	3%		7.5%		10%	
	U	A	U	A	U	A
1.	42.86-11.76		81.38-23.08		81.30-47.07	
2.	84.10-66.67		78.10-72.22		66.67-72.22	
3.	82.35-22.22		81.38-53.08		80.95-53.84	
4.	33.33-33.33		57.14-44.44		71.43-50.00	
5.	82.10-50.00		47.83-77.78		57.14-83.33	
6.	14.29-22.22		47.06-53.33		52.38-60.67	
7.	23.36-33.33		33.33-61.11		47.62-72.22	
8.	33.33-50.00		56.10-83.33		66.67-94.44	
9.	42.86-81.82		61.90-90.00		60.67-90.00	
10.	28.56-47.06		52.38-80.83		61.90-70.59	
11.	23.81-33.33		80.87-72.22		42.86-72.22	
12.	30.10-22.22		30.10-22.23		61.90-66.67	
13.	33.33-22.22		38.38-33.33		57.14-33.33	
14.	21.86-33.33		61.90-66.67		80.95-77.78	
15.	47.66-22.22		66.67-33.33		71.43-50.00	
16.	10-27.78		47.62-38.89		47.62-44.44	
17.	14.29-27.78		80.81-27.78		80.67-44.44	
18.	[illegible]		52.00-38.89		57.14-66.67	

Key: U: Unaided situation; A: Aided situation.

Table 8. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 7.

Film No.	5%	7.5%	10%
1.	2.145	2.117	0.932
2.	1.780	2.130	0.374
3.	1.929	0.202	1.713
4.	0	0.791	1.382
5.	0.747	1.929	1.765
6.	0.644	0.904	0.904
7.	0	1.734	1.557
8.	1.089	2.862	2.141
9.	1.363	0.747	1.055
10.	0.331	0.326	0.572
11.	0.658	2.720	1.844
12.	1.072	1.072	0.310
13.	0.768	1.197	1.486
14.	1.434	0.310	0.244
15.	1.648	2.077	1.382
16.	0.682	0.545	0.198
17.	1.040	0.284	1.030
18.	0.374	0.361	0.610

Table 8. Student's t Values Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situations in Table 7.

Film No.	5%	1.5%	10%
1.	2.145	2.117	0.932
2.	1.780	2.130	0.374
3.	1.829	0.208	1.716
4.	0	0.791	1.382
5.	0.747	1.929	1.765
6.	0.644	0.904	0.804
7.	0	1.724	1.357
8.	1.089	2.806	2.141
9.	1.363	0.747	1.059
10.	0.381	0.386	0.372
11.	0.855	2.720	1.864
12.	1.072	1.074	0.310
13.	0.768	1.197	1.486
14.	1.404	0.310	0.244
15.	1.648	2.077	1.382
16.	0.384	0.265	0.188
17.	1.040	0.324	1.080
18.	0.374	0.381	0.810

Table 9. Percentages of the Class A Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	14.95	17.12	16.81	34.23	24.30	45.94
2.	19.91	29.73	42.45	51.35	41.11	59.46
3.	16.82	19.81	30.84	31.53	36.45	39.64
4.	1.87	6.31	2.80	24.32	5.61	30.61
5.	6.60	16.21	6.60	21.62	6.60	21.62
6.	19.81	22.27	37.83	36.36	37.92	45.45
7.	0.93	15.45	3.74	24.54	13.08	33.64
8.	2.80	12.73	11.21	32.73	11.21	53.64
9.	45.79	41.82	47.66	51.82	69.16	60.91
10.	38.32	36.94	58.88	52.25	60.75	63.96
11.	5.61	17.27	5.61	24.54	7.48	40.00
12.	21.49	28.44	26.17	37.61	26.17	50.46
13.	3.74	9.90	11.21	21.62	13.08	23.42
14.	47.66	47.75	51.40	64.86	58.88	70.27
15.	40.19	36.04	65.42	49,55	69.16	56.76
16.	4.67	19.82	43.92	54.05	43.92	54.95
17.	20.56	32.43	41.12	41.44	44.86	45.96
18.	23.36	27.93	44.86	50.45	48.60	60.36

Key: U: Unaided situation; A: Aided situation.

Table 9. Percentages of the Class A Ratings within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	14.9%-17.1%		16.8%-24.2%		24.3%-45.9%	
2.	19.1%-29.7%		42.4%-51.3%		41.1%-59.4%	
3.	16.8%-19.0%		30.8%-31.8%		36.4%-39.6%	
4.	1.8%- 6.8%		8.8%-24.2%		9.8%-30.8%	
5.	6.8%-16.2%		8.8%-21.8%		8.8%-21.8%	
6.	19.8%-22.7%		27.8%-34.3%		37.9%-45.4%	
7.	0.9%-15.1%		3.7%-24.6%		15.0%-23.6%	
8.	2.8%-12.7%		11.2%-32.7%		11.8%-33.8%	
9.	45.7%-41.8%		47.8%-51.8%		33.1%-60.1%	
10.	38.3%-33.4%		33.8%-32.3%		30.7%-33.9%	
11.	3.8%-17.2%		3.8%-24.3%		7.4%-40.0%	
12.	21.4%-28.4%		24.1%-37.8%		25.1%-30.4%	
13.	3.7%- 9.9%		11.8%-21.8%		15.0%-23.4%	
14.	47.8%-47.7%		31.4%-34.8%		38.8%-70.2%	
15.	4.1%-33.0%		8.4%-40.3%		33.1%-33.7%	
16.	4.8%-12.8%		42.8%-34.0%		43.8%-34.8%	
17.	40.8%-32.4%		41.1%-41.4%		44.3%-43.8%	
18.	12.3%-17.8%		44.8%-30.4%		42.3%-30.3%	

Key: U: Unaided situation; A: Aided situation.

Table 10. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 9.

Film No.	5%	7.5%	10%
1.	0.438	2.966	3.360
2.	1.684	1.322	1.686
3.	0.573	0.110	0.487
4.	1.662	4.668	4.817
5.	2.266	3.196	3.196
6.	0.447	0.225	1.132
7.	0.279	0.225	0.360
8.	2.758	0.385	0.671
9.	0.594	0.617	1.283
10.	0.211	0.989	0.491
11.	0.855	3.945	6.000
12.	1.192	1.821	4.432
13.	1.604	2.082	1.988
14.	0.013	2.024	1.765
15.	0.633	2.382	1.898
16.	3.435	1.502	1.636
17.	1.994	0.048	0.164
18.	0.778	0.830	1.752

Table 10. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 9.

Film No.	5%	7.5%	10%
1.	0.438	2.958	3.360
2.	1.584	1.322	1.086
3.	0.375	0.113	0.487
4.	1.656	4.588	4.817
5.	2.266	3.196	3.196
6.	0.447	0.225	1.182
7.	0.279	0.285	0.360
8.	2.758	0.305	0.671
9.	0.844	0.617	1.283
10.	0.211	0.956	0.491
11.	0.805	2.945	6.000
12.	1.152	1.821	4.452
13.	1.804	2.082	1.808
14.	0.013	2.024	1.765
15.	0.855	2.308	1.598
16.	0.485	1.908	1.886
17.	1.994	0.042	0.194
18.	0.778	0.850	1.758

Table 11. Percentages of the Class B Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	38.09	23.53	47.62	23.53	57.14	35.29
2.	19.09	66.67	33.33	72.22	38.09	72.22
3.	42.86	5.55	52.38	5.55	71.42	16.67
4.	28.57	11.11	38.09	16.67	42.86	44.44
5.	14.28	38.89	14.28	55.55	14.28	61.11
6.	42.86	27.78	47.62	33.33	47.62	55.55
7.	4.76	33.33	4.76	50.00	19.05	72.22
8.	4.76	38.89	14.28	66.67	23.81	72.22
9.	42.85	38.89	47.61	38.89	71.43	61.11
10.	47.62	47.05	61.90	58.82	61.90	70.59
11.	14.28	33.33	14.28	44.44	33.33	72.22
12.	47.62	27.78	52.38	38.89	52.38	50.00
13.	19.05	22.22	38.10	38.89	47.62	44.44
14.	61.90	38.89	71.42	61.11	80.95	66.67
15.	47.62	16.67	52.38	33.33	71.42	38.89
16.	9.52	11.11	42.86	38.89	42.86	38.89
17.	14.28	38.89	19.05	44.44	23.81	55.55
18.	23.81	33.33	71.42	66.67	71.42	66.67

Key: U: Unaided situation; A: Aided situation.

Table II. Percentages of the Class B Ratings Within Given Percentage Deviations from the Corrected Ratings (Accuracy) in the Unaided and the Aided Situations.

Film No.	5%		7.5%		10%	
	U	A	U	A	U	A
1.	39.09-53.83		47.02-63.03		57.14-75.29	
2.	19.09-66.67		23.33-72.22		33.09-76.22	
3.	42.86- 8.33		52.38- 8.33		71.42-16.67	
4.	23.07-11.11		33.09-19.07		42.86-44.44	
5.	14.28-33.33		14.28-33.33		14.28-61.11	
6.	46.86-27.78		47.62-33.33		47.62-33.33	
7.	4.76-33.33		4.76-50.00		19.09-72.22	
8.	4.76-38.09		14.28-36.67		23.81-72.22	
9.	42.86-38.09		47.61-38.89		71.42-61.11	
10.	47.02-47.06		61.90-58.82		61.90-70.59	
11.	14.28-33.33		14.28-44.44		23.36-72.22	
12.	17.65-27.78		23.53-50.00		31.58-50.00	
13.	11.09-33.33		33.10-38.89		47.62-44.44	
14.	61.90-33.33		71.42-61.11		80.95-66.67	
15.	47.62-16.67		52.38-33.33		71.42-38.89	
16.	9.52-11.11		42.86-33.33		42.86-33.33	
17.	14.29-33.33		19.04-44.44		33.33-55.56	
18.	9.52-16.67		71.42-33.33		71.42-50.00	

Table 12. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 11.

Film No.	5%	7.5%	10%
1.	0.977	1.557	1.363
2.	3.011	2.423	4.558
3.	2.666	3.159	3.417
4.	1.346	1.481	0.992
5.	1.759	2.726	3.038
6.	0.978	0.904	0.494
7.	1.808	2.818	3.340
8.	2.144	3.352	3.022
9.	0.251	0.548	0.682
10.	0	0.196	0.572
11.	1.408	2.085	2.423
12.	1.269	0.842	0.148
13.	0.244	0	0.198
14.	1.434	0.682	1.021
15.	2.044	1.197	2.043
16.	0.163	0.249	0.249
17.	1.759	1.713	2.030
18.	0.658	0.320	0.320

Table 12. Student's t Value Calculated to Test the Difference Between the Values Given for the Unaided and the Aided Situation in Table 11.

Film No.	5%	7.5%	10%
1.	0.977	1.557	1.363
2.	3.011	2.422	4.338
3.	2.666	3.139	3.417
4.	1.346	1.481	0.992
5.	1.759	2.726	3.032
6.	0.978	0.904	0.494
7.	1.308	2.818	3.340
8.	2.144	3.336	3.022
9.	0.381	0.348	0.688
10.	0	0.196	0.372
11.	1.408	2.085	2.428
12.	1.282	0.842	0.148
13.	0.544	0	0.198
14.	1.454	0.882	1.081
15.	2.044	1.197	2.043
16.	0.168	0.249	0.249
17.	1.758	1.712	2.030
18.	0.886	0.380	0.380

Table 13. Values of the Means of the Raw Ratings in the Unaided and the Aided Situations for Each of the Two Groups (A and B) Used as a Basis for the Study of Consistency.

Film No.	Class A		Class B	
	U	A	U	A
1.	88.79-106.21		99.19-111.12	
2.	122.12-125.29		119.52-128.61	
3.	127.90-127-97		120.52-139.55	
4.	93.06-107-40		105.33-115.94	
5.	137.12-153.96		154.76-170.83	
6.	117.96-108.83		106.90-105.28	
7.	103.64-125.00		114.76-138.67	
8.	136.10-151.67		142.90-159.11	
9.	106.59-105.19		104.38-112.44	
10.	89.40- 98.86		99.38- 99.71	
11.	112.66-129.84		131.14-149.67	
12.	97.85- 92.04		91.90- 88.00	
13.	93.70-105.68		103.67-111.78	
14.	92.89- 99.79		97.38-106.11	
15.	94.53- 94.67		98.57- 94.17	
16.	75.73- 85.87		85.95- 90.50	
17.	83.90- 95.90		91.86-105.17	
18.	128.44-129.36		119.67-130.39	

Note: The films selected as those where best agreement between ratings were found are: 1, 10, 14, 17, 18 and 15.

Table IX. Values of the Means of the Raw Markings in the Unaided and the Aided Situations for Each of the Two Groups (A and B) Used as a Basis for the Study of Consistency.

Film No.	Class A		Class B	
	U	A	U	A
1.	96.79-106.81		99.18-111.18	
2.	182.12-185.89		118.82-138.61	
3.	187.90-187-87		180.82-139.35	
4.	98.08-107-40		103.83-115.94	
5.	107.12-182.96		134.78-170.83	
6.	117.98-188.83		106.90-103.28	
7.	108.84-182.00		114.78-138.87	
8.	186.10-181.87		146.80-139.11	
9.	106.89-103.19		104.88-112.44	
10.	88.40- 96.86		98.88- 99.71	
11.	112.88-189.84		181.14-149.07	
12.	87.89- 92.04		91.90- 96.00	
13.	93.70-106.86		109.87-111.78	
14.	92.89- 99.79		97.88-106.11	
15.	96.83- 94.87		98.87- 94.17	
16.	78,78- 86.87		88.98- 80.80	
17.	83.90- 93.90		91.88-108.17	
18.	188.44-189.88		118.87-130.38	

Note: The Films selected as those where both agreement between 2 Rings were found are: 1, 11, 16, 17, 18 and 10.

Table 14. Corrected Ratings Taken as Basis for the Study of Accuracy.

Film No.	Corrected Ratings
1.	101.33
2.	123.80
3.	115.94
4.	111.48
5.	117.95
6.	104.29
7.	141.86
8.	170.84
9.	101.45
10.	96.84
11.	146.55
12.	90.69
13.	118.22
14.	99.04
15.	95.48
16.	84.26
17.	94.21
18.	126.96

Table 14. Corrected Ratings Taken as Basis for the Study of Accuracy.

Film No.	Corrected Ratings
1.	101.33
2.	152.80
3.	115.94
4.	111.48
5.	117.95
6.	104.89
7.	141.83
8.	170.84
9.	101.48
10.	98.84
11.	146.55
12.	90.69
13.	112.22
14.	99.04
15.	93.48
16.	84.86
17.	94.81
18.	136.96

FIGURE 1

GRAPHICAL DISPLAY OF THE RAW RATINGS AVERAGES
OF GROUP A
IN THE UNAIDED AND IN THE AIDED SITUATION

Fig. 1.

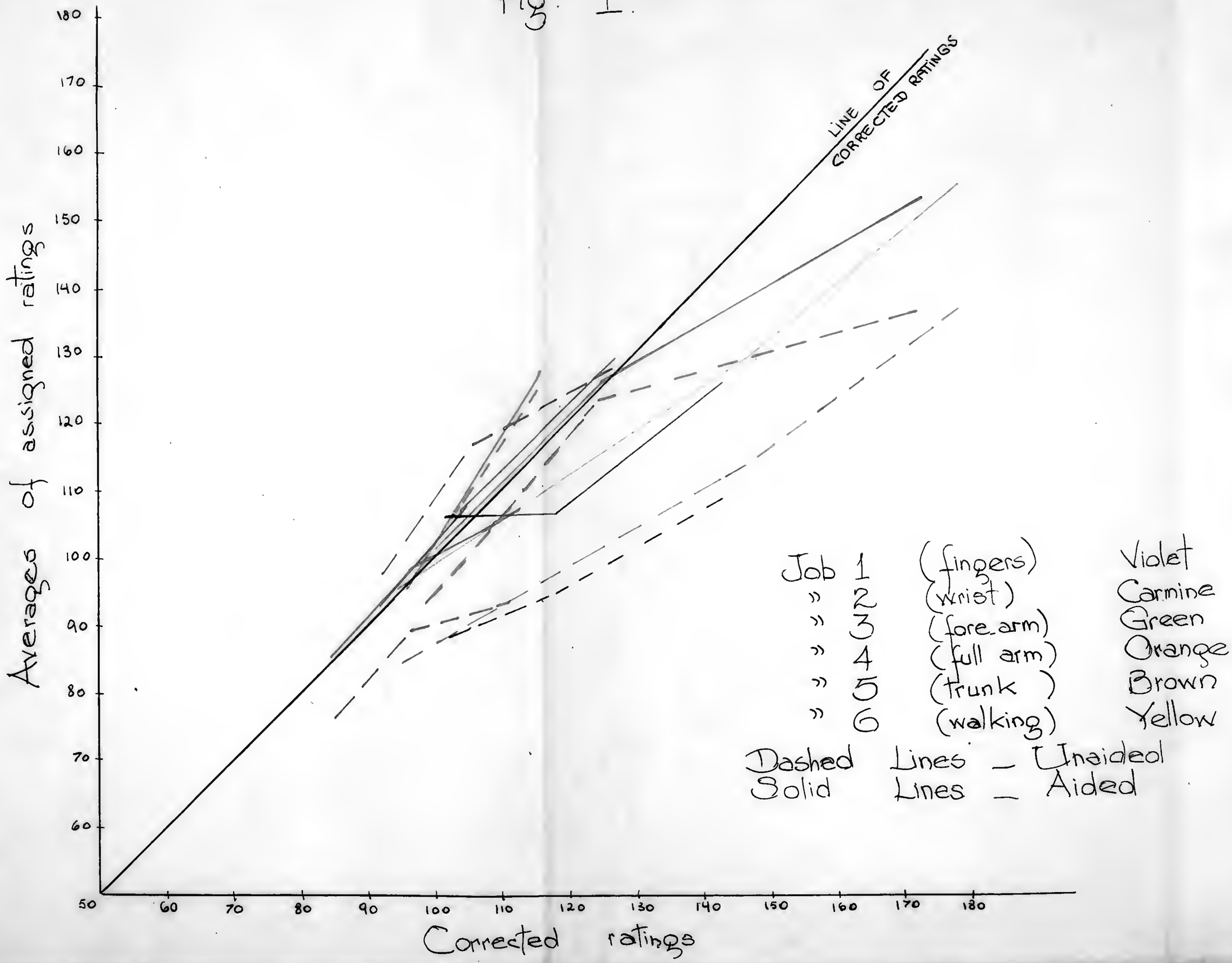
Averages of assigned ratings
180
170
160
150
140
130
120
110
100
90
80
70
60
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Corrected ratings
LINE OF CORRECTED RATINGS
Job 1 (fingers) Violet
» 2 (wrist) Carmine
» 3 (fore_arm) Green
» 4 (full arm) Orange
» 5 (trunk) Brown
» 6 (walking) Yellow
Dashed Lines – Unaided
Solid Lines – Aided

Fig 1.

Average Judged Length of Lines
Corrected
LINE OF CORRECTED RATINGS
Job 1 (finger
" 2 (wrist
" 3 (fore-
" 4 (full
" 5 (trun
" 6 (walk
Dashed Lines
Bold Lines

APPENDIA B:

EXPLANATION OF STATISTICAL PROCEDURE

EXPLANATION OF STATISTICAL PROCEDURE

The percentages of ratings within given percentage deviations from the raw averages and from the corrected ratings, found respectively in the studies of consistency and accuracy, were tested for significance by means of the Student's t variable.

This test requires the assumption that the ratings obtained came from a normally distributed population.(12)

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12. Edwards, A., "Experimental design in Psychological Research", New York, Mc Graw-Hill Book Co., 1950.

This assumption was made as explained in the Data section of this thesis.

The formula used to express Student's t variable was:

$$t = \frac{p_1 - p_2}{e}$$

where p_1 is the percentage deviation from the raw ratings average, in the consistency study, or from the corrected rating, in the accuracy study, in the unaided situation; p_2 is the same statistics in the aided situation and e is the standard error of the quantity $p_1 - p_2$, being given by the formula:

EXPLANATION OF STATISTICAL PROCEDURES

The percentages of ratings within given percentage deviations from the raw averages and from the corrected ratings, found respectively in the studies of consistency and accuracy, were tested for significance by means of the Student's t variable.

This test requires the assumption that the ratings obtained came from a normally distributed population.(18)

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18. Edwards, A., "Experimental design in psychological Research", New York, The Dryden Press Co., 1950.

This assumption was made as explained in the next section of this thesis.

The formula used to express Student's t variable was:

$$t = \frac{D_r - E_r}{\sigma}$$

given in the standard error of the formula $D_r - E_r$, where E_r is the average error of the final rating and D_r is the same variable in the first rating, found in the corrected average, in the consistency study, or from the corrected rating, in the accuracy study; where D_r is the percentage deviation from the raw ratings

$$e = \sqrt{ab\,(1/n_1 + 1/n_2)}$$

where:

$$a = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2} \qquad \text{and} \qquad b = 1 - a$$

and n_1 and n_2 are the number of ratings used in each situation. The number of degrees of freedom is given by the formula:

$$\text{d. f.} = n_1 + n_2 - 2$$

The test consisted of proposing the hypothesis that the percentage deviations found were typical percentage deviations drawn from a normal population. The value of t was calculated and compared with the limiting values of t given by a table.(13) If the value of t calculated is

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13. C. C. Peters and R. Van Voorhis, "Statistical Procedures and Their Mathematical Basis", New York, Mc Graw-Hill Book Co., 1940.

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greater than the table value, at the level of significance chosen, the hypothesis is not tenable; in other words, there is a difference between the two percentages considered which is greater than should be expected of typi-

$$e = \sqrt{\exp\left(1/u_1^2 + 1/u_2^2\right)}$$

where:

$$s = \frac{u_1^2 + u_2^2}{u_1^2 + u_2^2} \qquad \text{and} \qquad p = 1 - e$$

and u_1^2 and u_2^2 are the number of ratings used in each situation. The number of degrees of freedom is given by the formula:

$$d.f. = u_1^2 + u_2^2 - 2$$

The test consisted of proposing the hypothesis that the percentage deviations found were typical percentage deviations drawn from a normal population. The value of t was calculated and compared with the tabled values of t given by a table.[19] If the value of t obtained is

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[19] ... Fisher and F. Yates, "Statistical Tables for Biological, Agricultural and Medical Research", New York, The Macmillan Co., 1943.

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greater than the table value, we may speak of significance, which is the term used to designate a hypothesis which is not rejected; in other words, there is a difference between the two populations considered, and the hypothesis is not rejected; in other words,

cal percentage deviations drawn from normal population.

Two levels of significance were chosen: 1% and 5%.

Statistically speaking, a statement is made at the n% level of significance when one has only n chances out of 100 that the statement made is not true.

The limiting values of t for the number of degrees of freedom involved in all cases were:

At 1% level of significance: $t = 2.58$

At 5% level of significance: $t = 1.97$

The number of ratings obtained were as follows:

Group A

Unaided: 107

Aided: 111

Group B

Unaided: 21

Aided: 18

.ost percentage deviations drawn from normal population.

Two levels of significance were chosen: 1% and 5%.

Statistically speaking, a statement is made at the 1%
level of significance when one has only 1 chances out of
100 that the statement made is not true.

The tabling values of t for the number of degrees of
freedom involved in all cases were:

At 1% level of significance: t = 2.58

At 5% level of significance: t = 1.97

The number of ratings obtained were as follows:

Group A

United: 107

Aided: 111

Group B

United: 91

Aided: 79

APPENDIX C

SAMPLE CALCULATIONS

APPENDIX D

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS

Calculation of mean or average values, example from Group B, unaided, film no. 1:

$$M = \frac{\sum \text{ratings}}{\text{No. of ratings}} = \frac{2083}{21} = 99.19$$

Calculations of the percentage of ratings within given percentage deviations from the corrected ratings, example from Group A, unaided, film no. 1:

$$M = 101.33$$

$M \pm 5\%$	$M \pm 7.5\%$	$M \pm 10\%$
96.26 to 106.40	93.37 to 108.93	91.20 to 111.46
$\frac{100 \times 16}{107} = 14.95$	$\frac{100 \times 18}{107} = 16.82$	$\frac{100 \times 26}{107} = 24.30$

Calculations of Student's t values, example from Group A, accuracy, film no. 1, within 5%:

$$t = \frac{0.1712 - 0.1495}{0.1603 \times 0.8397 \left(1/107 + 1/107 \right)} = 0.438$$

Significance: not significant at both 1% and 5% levels.

SAMPLE CALCULATIONS

Calculation of mean or average values, example from Group B, unaided, film no. 1:

$$M = \frac{\text{sum of readings}}{\text{no. of readings}} = \frac{6083}{21} = 99.19$$

Calculations of the percentage of readings within given percentage deviations from the corrected readings, example from Group A, unaided, film no. 1:

M = 101.33

M ± 5%	M ± 7.5%	M ± 10%
96.26 to 106.40	93.71 to 108.95	91.20 to 111.46

$$\frac{100 \times 15}{107} = 14.02 \qquad \frac{100 \times 10}{107} = 10.06 \qquad \frac{100 \times 26}{107} = 24.30$$

Calculations of standard t values, example from Group A, accuracy, film no. 1, within 5%:

$$t = \frac{0.7218 - 0.1429}{\sqrt{0.1429 \times 0.8571 \left(\frac{1}{107} + \frac{1}{107} \right)}} = 0.499$$

Significance: not significant at 95% to one or fewer.

Metronome beats and frames per cycle.

Film no.	Metronome	Frames/cycle
1	120	9
2	100	21
3	176	14
4	80	13
5	204	10
6	70	29
7	168	6
8	138	15
9	154	16
10	70	15
11	168	12
12	60	33
13	144	7
14	80	26
15	130	19
16	60	17
17	108	19
18	84	24

Metronome beats and frames per cycle.

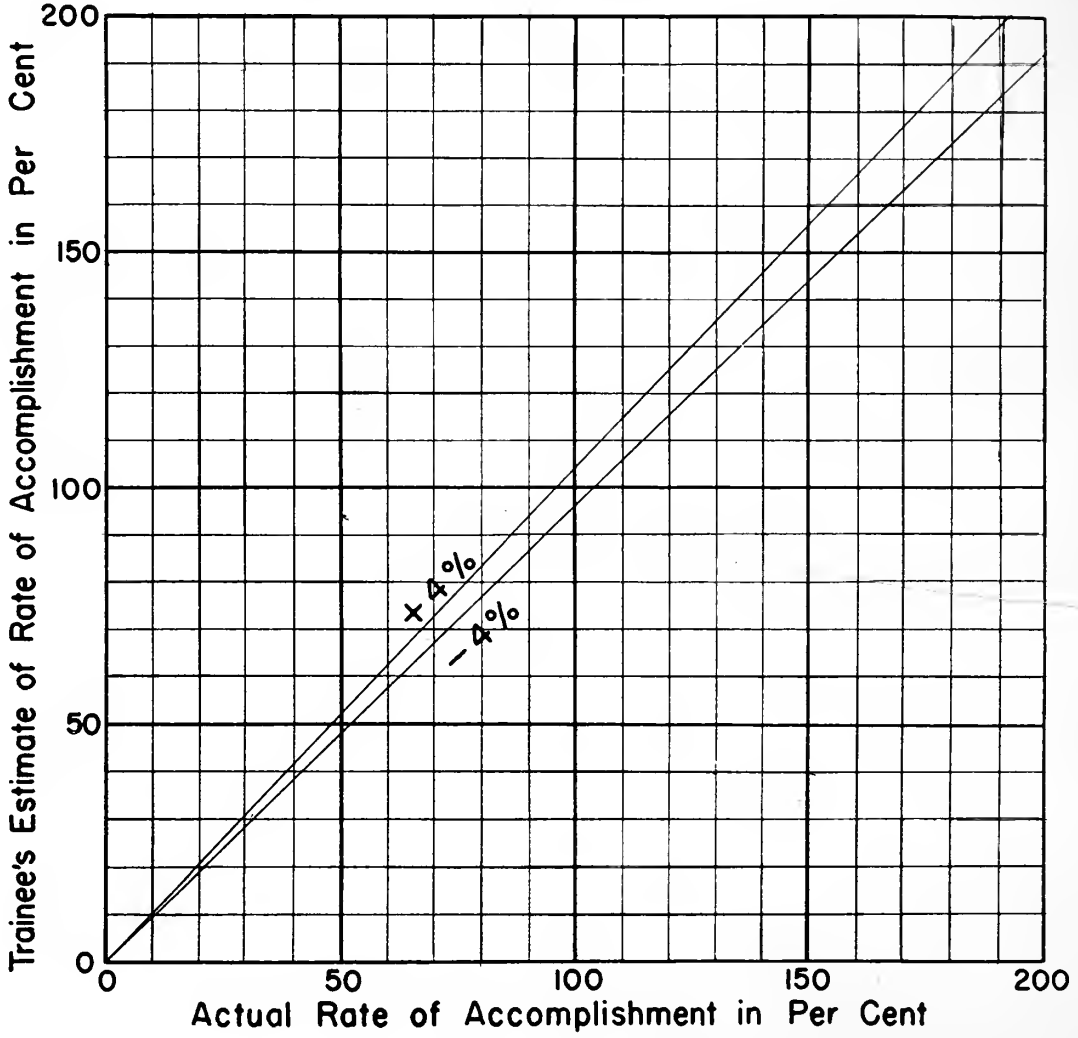
Film no.	Metronome	Frames/cycle
1	120	3
2	100	21
3	178	14
4	80	13
5	204	10
6	70	29
7	168	6
8	132	15
9	154	18
10	70	15
11	160	15
12	60	32
13	144	7
14	80	26
15	120	19
16	90	17
17	108	18
18	84	24

RATING EFFICIENCY COMPARISON SHEET NO. ___

OPERATION _____

Sequence Number	Rating of Accomplishment in Per Cent	
	Trainee's	Actual
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

COMPARISON GRAPH

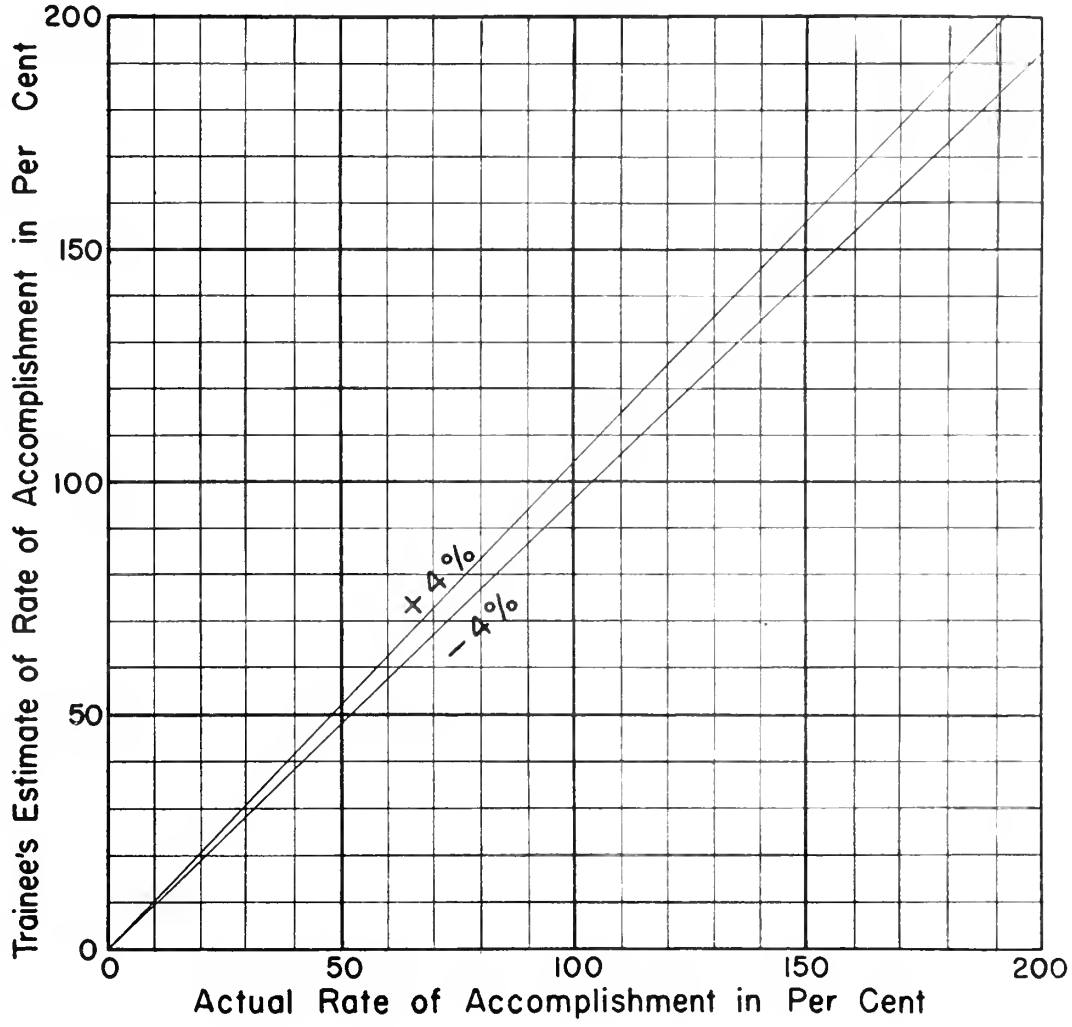


RATING EFFICIENCY COMPARISON SHEET NO. ___

OPERATION _____

Sequence Number	Rating of Accomplishment in Per Cent	
	Trainee's	Actual
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		

COMPARISON GRAPH



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Thesis 15636
M685 Monteiro
Investigation of the effect of the amount of body used on the accuracy and consistency of pace-rating (multi- image loop).